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# SCIENCE

FRIDAY, FEBRUARY 25, 1916

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

## THE INTERRELATIONS OF PURE AND APPLIED CHEMISTRY<sup>1</sup>

WITHIN the past fifty years there has been a revolution in civilized industries more far-reaching in its effects than the rise or fall of dynasties or the arbitrament of war. It is a quiet, peaceful revolution, so unobtrusive that even its active agents have rarely been aware of its significance. Even the astounding efficiency of armies in the present European war is but a minor item in the forward movement.

This revolution, which is still going on, and may continue indefinitely, is both simple and complex. It is merely the gradual substitution of scientific accuracy for empiricism, of quantitative and rational methods for rule of thumb. It means better service, better wares, intelligent agriculture, improved sanitation, the suppression of epidemics, and the prevention of waste. Through its agency the luxuries of a century ago have become almost necessities; travel has been made easier and cheaper; commerce is broadened; and all the nations of the earth are now brought together in a community of interests which is only interrupted temporarily by war. Even the horrors of war are somewhat mitigated by the beneficent activities of the Red Cross service, which owes much of its effectiveness to the discoveries of science; an effectiveness which would have been impossible in the days of our grandfathers. With the aid of modern inventions the powers not at war are now able to relieve much of the suffering due to war. Steam and the telephone have made charity more prompt and

<sup>1</sup> Address before Section VII. of the Pan-American Scientific Congress, January 3, 1916.

dence in the reader. Other species, as, for example, *P. cyclops* (von Linstow), *P. nemetosome* (Leidy) and *P. salvelina* (Linton), are given less space, such being, as a rule, records of material that either did not admit of certain identification, or at least were inadequately described. Such species as *P. ambloplites* (Leidy) and *P. perplexus* (LaRue), which are American species and have been studied by the author, are described in detail, and with such discrimination that there should not be any confusion in future identifications of these forms. Comparative tables of selected characters of Proteocephalid species are given. Such tables are of peculiar value in the identification of such soft-bodied forms as cestodes and trematodes, whose superficial appearance is affected diversely by preserving fluids. Under distribution it is of interest to note that amphibian Proteocephalids are known only from the two continents, North America and Australia, while those of reptiles and fish are known from all the continents.

The following conclusions are of general interest:

1. A species of *Proteocephalus* may occur in different host species of the same genus. Five species are limited exclusively to various species within the same host genus.

2. A species may occur in the different genera of the same family.

3. A species may occur in the members of closely allied genera, *i. e.*, of the same order. Four cases are known.

4. A species may occur in families of very wide relationship, *i. e.*, of different orders. There are two cases, of which one is doubtful.

A further general statement is: The parasitic infestation of the host is determined by the food eaten.

A suggestive fact, pointing to a wide and fruitful field of investigation, is indicated when it is noted that in this monograph of 350 pages less than 2 are devoted to the life histories of the Proteocephalidæ, and these pages are largely taken up with a discussion of probable life histories.

As to the relationship of the Proteocephalids to other cestodes, the author finds that struc-

turally they are to be considered as being closely allied to the Tetracophyllidæ, while their relationship to the Cyclophyllidæ is distant. The inclusion and long retention of the Proteocephalids in the great genus *Tænia* was due to external features alone.

The origin of the Proteocephalids is discussed and the suggestion made that it may have been some member of the family Lepisosteidæ that is responsible for the introduction of these cestodes into the fresh-water environment.

A bibliography of 78 authors and 144 titles is appended. These range in time from 1766 to 1912.

EDWIN LINTON

WASHINGTON AND JEFFERSON COLLEGE,

WASHINGTON, PA.,

January 22, 1916

## SCIENTIFIC JOURNALS AND ARTICLES

THE opening (January) number of Vol. 17 of the *Transactions of the American Mathematical Society* contains the following papers:

W. F. Osgood: "On functions of several complex variables."

E. B. Van Vleck and F. H'Doubler: "A study of certain functional equations for the  $\theta$ -functions."

B. A. Bernstein: "A set of four independent postulates for Boolean algebras."

L. P. Eisenhart: "Transformations of surfaces  $\Omega$  (second memoir)."

E. J. Moulton: "On figures of equilibrium of a rotating compressible fluid mass; certain negative results."

THE February number (Vol. 22, No. 5) of the *Bulletin of the American Mathematical Society* contains: Report of the ninth regular meeting of the Southwestern Section, by O. D. Kellogg; "A note on the problem of Lagrange in the calculus of variations," by G. A. Bliss; "Concerning a non-metrical pseudo-archimedean axiom," by R. L. Moore; "A type of singular points for a transformation of three variables," by W. V. Lovitt; Review of Goldenring's *Die elementargeometrischen Konstruktionen des regelmässigen Siebzehnecks*, by R. C. Archibald; "Shorter Notices;" Wentworth and Smith's *Plane Trigonometry and Tables*

and Horsburgh's *Modern Instruments and Methods of Calculation*, by C. C. Grove; Longley's *Tables and Formulas*, revised edition, by Joseph Lipka; Enriques' *Vorlesungen über projektive Geometrie*, second German edition, by A. Emch; Miller's *Descriptive Geometry*, Armstrong's *Descriptive Geometry*, and Grossmann's *Darstellende Geometrie*, by Virgil Snyder; "Notes;" and "New Publications."

### SPECIAL ARTICLES

#### AN APPARENT LATERAL REACTION BETWEEN IDENTICAL PENCILS OF LIGHT WAVES, CROSSING EACH OTHER AT A SMALL ANGLE<sup>1</sup>

1. *Methods*.—To exchange the component beams in the interferometer, to mutually replace the two pencils which interfere, is not an unusual desideratum. To replace two pencils of component rays travelling more or less parallel to each other, by pencils more or less normal to each other, to be able to operate

pencils are diffracted along the same direction  $G'T$ , into the telescope at  $T$ .

If now the opaque mirrors  $m, n, M, N$ , are appropriately rotated, the parallel component beams  $GmMG'$  and  $GnNG'$  may be replaced by  $GmNG'$  and  $GnMG'$ , respectively, which cross each other at  $c$ , while the pencils impinging at  $G'$  have been exchanged.

There is an essential difference in these two cases. Whereas in the case of parallel rays,  $a'$ , and  $b'$ , the double diffraction is an increment of either, in the case of the crossed rays,  $a$  and  $b$ , it is a decrement and the system tends to become achromatic. In the latter case one should suppose that homogeneous light and a wide slit only could be used in the interferometer. But this is not so.

2. *Results*.—The reflecting gratings with large dispersion constants in my possession waste too much light and the work is thus burdensome. The following results were

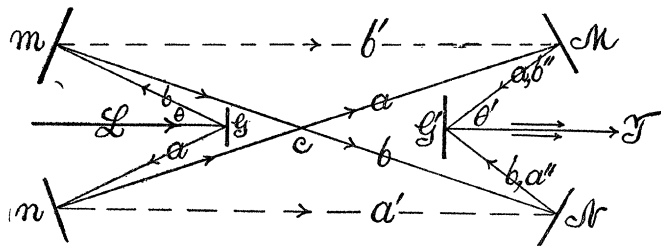


FIG. 1.

at the point of intersection of corresponding pencils of rays from the same source, crossing at any angle, may be of interest in a variety of operations and may even suggest novel experiments.

In Fig. 1, I have sketched one of many forms of apparatus of the kind in question, with which I have recently been working. A beam of parallel rays from a collimator,  $L$ , impinges on the reflecting plate grating  $G$ . The diffracted pencils  $a, b$ , are reflected by the opaque mirrors  $n$  and  $m$  into  $b'$  and  $a'$ , to be again reflected by the opaque mirrors  $M$  and  $N$  into the pencils  $b''$  and  $a''$ . These impinge on the plate grating  $G'$ , so placed that both

therefore investigated with a good ruled transmitting grating, adjusted to secure the double diffraction of Fig. 1 in a single grating. This simplifies the method and the interferences are much more expeditiously found. The rays in such an apparatus must cross in the glass plate of the grating at  $c$ .

In the case of parallel rays  $Nn, Mm$ , white light and a fine slit, I obtained the linear phenomena of reversed spectra as usual. On using homogeneous light and a wide slit superb interferometer fringes were obtained. In every instance these are parallel striations crossing the whole field *uniformly*. They may easily be made coarser or finer, or rotated at pleasure, but a given field never shows independent groups; *i. e.*, there is no second periodicity

<sup>1</sup> Work done on a grant from the Carnegie Institution of Washington, D. C.